



SEQUENCE LISTING

<110> Pizza, Mariagrilia
Fontana, Maria Rita
Giannelli, Valentina
Rappuoli, Rina

<120> Immunogenic Detoxified Mutants Of Cholera Toxin

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<150> 08/981,209
<151> 1997-12-22

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<151> 1995-06-30

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Ala Gly Gly Leu Leu Pro Arg Gly Gln Gln Glu Ala Tyr Glu Arg Gly
20 25 30

Thr Pro Ile Asn Ile Asn Leu Tyr Glu His Ala Arg Gly Thr Val Thr
35 40 45

Gly Asn Thr Arg His Asn Asp Gly Tyr Val Ser Thr Thr Val Thr Leu
50 55 60

Arg Gln Ala His Leu Ile Gly Gln Asn Ile Leu Gly Ser His Asn Glu
65 70 75 80

Tyr Tyr Ile Tyr Val Val Ala Pro Ala Pro Asn Leu Phe Asp Val Asn
85 90 95

Gly Val Leu Gly Arg Tyr Ser Pro Tyr Pro Ser Glu Asn Glu Phe Ala
100 105 110

Ala Leu Gly Gly Ile Pro Leu Ser Gln Ile Ile Gly Trp Tyr Arg Val
115 120 125

Ser Phe Gly Ala Leu Glu Gly Gly Met Gln Arg Asn Arg Asp Tyr Arg
130 135 140

Gly Asp Leu Phe Ser Gly Leu Thr Val Ala Pro Asn Ala Asp Gly Tyr
145 150 155 160

Gln Leu Ala Gly Phe Pro Ser Asn Phe Pro Ala Trp Arg Glu Met Pro
165 170 175

Trp Ser Thr Phe Ala Pro Glu Gln Cys Val Pro Asn Asn Lys Glu Phe
180 185 190

Lys Ser Gly Val Cys Ile Ser Ala Thr Asn Val Leu Gly Lys Tyr Asp
195 200 205

Leu Met Asn Phe Lys Lys Leu Leu Lys Arg Arg Leu Ala Leu Thr Phe
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Phe Met Ser Asp Asp Asp Phe Thr Gly Val His Gly Glu Lys Asp Glu
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Leu

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Asn Asp Asp Lys Leu Tyr Arg Ala Asp Ser Arg Pro Pro Asp Glu Ile
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Lys Gln Phe Arg Ser Leu Met Pro Arg Gly Ser Glu Tyr Phe Asp Arg
20 25 30

Gly Thr Gln Met Asn Ile Asn Leu Tyr Asp His Ala Arg Gly Thr Gln
35 40 45

Thr Gly Phe Val Arg His Asp Asp Gly Tyr Val Ser Thr Ser Ile Ser
50 55 60

Leu Arg Ser Ala His Leu Val Gly Gln Tyr Ile Leu Ser Gly His Ser
65 70 75 80

Leu Thr Ile Tyr Ile Val Ile Ala Asn Met Phe Asn Val Asn Asp Val
85 90 95

Ile Ser Ala Tyr Ser Pro His Pro Asp Glu Gln Glu Val Ser Ala Leu
100 105 110

Gly Gly Ile Pro Tyr Ser Gln Ile Tyr Gly Trp Tyr Arg Val His Phe
115 120 125

Gly Val Leu Asp Glu Gln Leu His Arg Asn Arg Gly Tyr Arg Asp Arg
130 135 140

Tyr Tyr Ser Asn Leu Asp Ile Ala Pro Ala Ala Asp Gly Tyr Gly Leu
145 150 155 160

Ala Gly Phe Pro Pro Gln His Arg Ala Trp Arg Glu Glu Pro Trp Ile
165 170 175

His His Ala Pro Pro Gly Cys Gly Asn Ala Pro Arg Ser Ser Met S r
180 185 190

Asn Thr Cys Asp Glu Lys Thr Gln Ser Leu Gly Val Lys Phe Leu Asp
195 200 205

Glu Tyr Gln Ser Lys Val Lys Arg Gln Ile Phe Ser Gly Tyr Gln Ser
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Asp Ile Asp Thr His Asn Arg Ile Lys Asp Glu Leu
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Asn Gly Asp Arg Leu Tyr Arg Ala Asp Ser Arg Pro Pro Asp Glu Ile
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Lys Arg Ser Gly Gly Leu Met Pro Arg Gly His Asn Glu Tyr Phe Asp
20 25 30

Arg Gly Thr Gln Met Asn Ile Asn Leu Tyr Asp His Ala Arg Gly Thr
35 40 45

Gln Thr Gly Phe Val Arg Tyr Asp Asp Gly Tyr Val Ser Thr Ser Leu
50 55 60

Ser Leu Arg Ser Ala His Leu Ala Gly Gln Ser Ile Leu Ser Gly Tyr
65 70 75 80

Ser Thr Tyr Tyr Ile Tyr Val Ile Ala Thr Ala Pro Asn Met Phe Asn
85 90 95

Val Asn Asp Val Leu Gly Val Tyr Ser Pro His Pro Tyr Glu Gln Glu
100 105 110

Val Ser Ala Leu Gly Gly Ile Pro Tyr Ser Gln Ile Tyr Gly Trp Tyr
115 120 125

Arg Val Asn Phe Gly Val Ile Asp Glu Arg Leu His Arg Asn Arg Glu
130 135 140

Tyr Arg Asp Arg Tyr Tyr Arg Asn Leu Asn Ile Ala Pro Ala Glu Asp
145 150 155 160

Gly Tyr Arg Leu Ala Gly Phe Pro Pro Asp His Gln Ala Trp Arg Glu
165 170 175

Glu Pro Trp Ile His His Ala Pro Gln Gly Cys Gly Asp Ser Ser Arg
180 185 190

Thr Ile Thr Gly Asp Thr Cys Asn Glu Glu Thr Gln Asn Leu Ser Thr
 195 200 205
 Ile Tyr Leu Arg Glu Tyr Gln Ser Lys Val Lys Arg Gln Ile Phe Ser
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 20 25 30
 Arg Gly Thr Gln Met Asn Ile Asn Leu Tyr Asp His Ala Arg Gly Thr
 35 40 45
 Gln Thr Gly Phe Val Arg His Asp Asp Gly Tyr Val Ser Thr Ser Ile
 50 55 60
 Ser Leu Arg Ser Ala His Leu Val Gly Gln Thr Ile Leu Ser Gly His
 65 70 75 80
 Ser Thr Tyr Tyr Ile Tyr Val Ile Ala Thr Ala Pro Asn Met Phe Asn
 85 90 95
 Val Asn Asp Val Leu Gly Ala Tyr Ser Pro His Pro Asp Glu Gln Glu
 100 105 110
 Val Ser Ala Leu Gly Gly Ile Pro Tyr Ser Gln Ile Tyr Gly Trp Tyr
 115 120 125
 Arg Val His Phe Gly Val Leu Asp Glu Gln Leu His Arg Asn Arg Gly
 130 135 140
 Tyr Arg Asp Arg Tyr Tyr Ser Asn Leu Asp Ile Ala Pro Ala Ala Asp
 145 150 155 160
 Gly Tyr Gly Leu Ala Gly Phe Pro Pro Glu His Arg Ala Trp Arg Glu
 165 170 175
 Glu Pro Trp Ile His His Ala Pro Pro Gly Cys Gly Asn Ala Pro Arg
 180 185 190
 Ser Ser Met Ser Asn Thr Cys Asp Glu Lys Thr Gln Ser Leu Gly Val
 195 200 205
 Lys Phe Leu Asp Glu Tyr Gln Ser Lys Val Lys Arg Gln Ile Phe Ser
 210 215 220

Gly Tyr Gln Ser Asp Ile Asp Thr His Asn Arg Ile Lys Asp Gln Leu
225 230 235 240